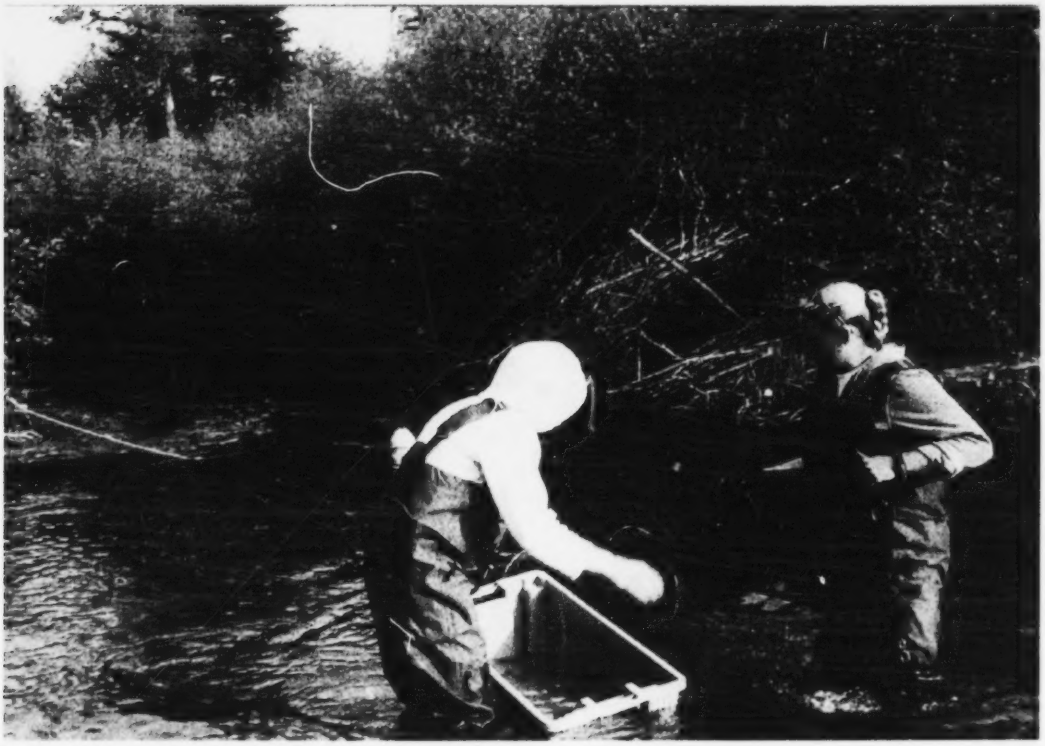
Population parameters of Cape Breton brook trout populations in River Denys, Lake O'Law Brook of Margaree River, and Cold Brook of Middle River. Interim draft data report. 2005.



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Acknowledgments

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Abstract

Brook trout movements and population parameters were assessed on three stream systems from mid May to mid September in Cape Breton, Nova Scotia. The total number of trout captured in each river was 2149 in River Denys, 792 in Lake O' Law, and 1863 in Cold Brook. The majority (96%) of the 4785 brook trout captured were migrating upstream. Seventy five percent of upstream migration occurred in June and July. The brook trout population estimate was 43,651 (30,000 - 67,000) for River Denys, 7,574 (4,400 - 12,000) for Lake O' Law Brook, and 21,887 (16,000 - 31,000) for Cold Brook. River Denys tended to have larger trout compared to the other two systems. Approximately 7% of River Denys trout population was longer than 30 cm compared with 2% in Lake O' Law Brook and 1% in Cold Brook. Mean length at age at the time of capture was 15 cm at one year, 22 cm at two years, 32 cm at three years, and 40 cm at four years. Annual mortality rate ranged from 71%-86% for three year old trout and was 100% for four year of trout.

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Introduction

The brook (speckled) trout, *Salvelinus fontinalis*, inhabit lakes and rivers across Nova Scotia. Life strategies of brook trout can vary depending on region and habitat, some remain in freshwater throughout their lives while others migrate to salt water. Anadromy in brook trout is not well understood but is thought to satisfy a need for more food and space. Generally sea run trout migrate to estuaries in early spring and remain in brackish or salt water for about two months before returning to freshwater in early summer (Miles 1985, Wilder 1952, White 1940, Dupuis et al. 1991, Thompson 1991, Montgomery et al. 1990, Castonguay et al. 1982, Smith and Saunders 1958).

Overexploitation and habitat loss are believed to be responsible for declines in sea run brook trout populations throughout their North American range (Ryther 1997). In Nova Scotia, anadromous trout exhibit heavy mortality rates that result in very few individuals in the population living past the age of four years (MacMillan and LeBlanc 2000). In recent years Nova Scotia anglers and their organizations have become increasingly concerned about the status of anadromous trout populations.

This study originated from the fall 2003 Recreational Fishing Advisory Council meeting in Cape Breton. Anglers recommended an assessment of the trout resource in the River Denys. Two additional systems, Lake O'Law Brook, Margaree River, and Cold Brook, Middle River were included as study sites. Historical studies on Lake O'Law Brook provided baseline for comparison. Habitat enhancement on Lake O'Law Brook was undertaken by Trout Nova Scotia and the Margaree Salmon Association. Special management options for brook trout in Lake O'Law Brook are being considered. Cold Brook, is included in the Middle River Special Management Area.

Brook trout populations were assessed for population number, size and age structure, timing of the upstream migration, mortality rates, growth rates, and river habitat suitability. The purpose of this study was to gage the health and status of three trout populations in Cape Breton, Nova Scotia.

Methods

Brook trout movements and population parameters were assessed in River Denys, Lake O'Law Brook, Margaree River, and Cold Brook, Middle River. Fish populations were live trapped with the use of fyke nets. Each fyke net consisted of a hoop net that was attached to two 0.5m x 5m wings. Each hoop net had a depth of 0.5 metres, leading to a series of six circular hoops and a bag at the tail. Mesh size for nets was 1 cm^2.

Fish were captured, counted, adipose fin clipped (marked), measured to the nearest millimeter, weighed to the nearest gram, and released. Mean length at age at time of capture was determined. Several volunteers provided advice with the project set up and collected information on trout populations through the use of angling (Table 1). Automatic temperature data loggers recorded temperature every hour in the main branch and in the tributary of study sites.

The marking sites were located downstream of the capture sites (Figure 1). The adipose fin was removed from brook trout captured and release at the marking sites. A 5% mortality rate was assumed from handling stress on marked trout. The 5% mortality rate was used to estimate the total number of trout available for capture and incorporated into the population estimate equation by multiplying the total number of marked trout by 95%. Adipose fin clipped trout that were captured at the capture site were recorded as recaptures. Trout from the capture sites were marked with an anal fin clip and released to assess the proportion of repeat captures. The proportion of repeat captures was used to estimate the number of captures in the modified Petersen population estimate equation. The modified Petersen equation from Ricker (1975) was

$N = (M+1) / (C^* + 1)^*(R+1)$, where;

N = Number in the population,

M = number of marked trout * 0.95,

C^* = number of captured trout at capture site - (number of captured trout at capture site * proportion of repeat captures from the capture site),

and R = number of recaptures.

Results and Discussion

Brook trout movement patterns were assessed in three Cape Breton stream systems from mid May to mid September. Water temperatures in the main branch of River Denys warmed to stressful levels for brook trout in late August and early September (Table 2). Brook trout migrate to cooler regions when the daily mean water temperature exceeds 20°C (MacMillan et. al 2005, MacMillan and Crandlemere 2005). Margaree River and Middle River remained at temperatures that are considered to be suitable for brook trout throughout the summer.

The number of trout captured in each river was 2149 in River Denys, 792 in Lake O'Law, and 1863 in Cold Brook (Figure 2). Upstream brook trout migration into the cool headwaters of River Denys declined in August when water temperatures warmed (Table 3). Upstream movement of brook trout in Cold Brook, Middle River and in Lake O'Law Brook, Margaree River occurred in July and August. These differences may be do to the fact that Cold Brook and Lake O'Law are tributaries of a much larger system. The summer of 2004 was relatively cool and large trout may have remained in the main branch of Margaree River and Middle River instead of using the tributaries as cool water refugia.

The estimated number in each of the brook trout populations was 43,651 (30,000 - 67,000) for River Denys, 7,574 (4,400 - 12,000) for Lake O' Law Brook, and 21,887 (16,000 - 31,000) for Cold Brook (Table 4). River Denys tended to have larger trout compared to the other two systems (Figure 3). Fish length is often related to growth and anadromy. Sea run trout are often much larger than resident trout because they migrate to estuaries or salt water where food is abundant. Approximately 7% of River Denys trout population was longer than 30 cm compared to only 2% in Lake O'Law Brook and 1% in Cold Brook (Table 5). In River Denys, mean trout length at age at the time of capture was 15 cm at one year, 22 cm at two years, 32 cm at three years, and 40 cm at four years. Mean length at age for brook trout in Lake O'Law Brook and Cold Brook was 15 cm at one years, 22 cm and 21 cm and two years, and 31 cm and 33 cm at three years, and was 37 cm and 39 cm at four years, respectively (Table 6).

Annual mortality rates ranged from 71%-86% for three years old trout and were 100% for four year old trout on River Denys and LakeO'Law Brook (Table 7). One four-year-old and one five-year-old trout were captured from Cold Brook, Middle River. High mortality of anadromous brook trout has also occurred on rivers that flow into the Northumberland Strait. Five-year-old brook trout were absent from the creel of 533 anglers. Catch rates (number of trout caught per hour) tend to be low (~0.08) during the first month of the angling season between 15 April - 15 May, but angler activity was high (1153 angler hours) and resulted in significant numbers of trout (1093 brook trout and 803 brown trout) being removed (MacMillan and LeBlanc 2002). White (1940) captured five-year-old and six-year-old brook trout in Moser River during an assessment of the sea run population.

Future studies of sea run trout will be undertaken on two mainland populations. These studies are planned for the West River of Sheet Harbour and the Moser River in Halifax County. Once these populations are assessed comparisons will be made with Cape Breton populations and a more detailed report will follow.

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Table 1. List of volunteers and professionals that have contributed to the trout assessment on River Denys, Lake aO'Law Brook of Margaree River, and Cold Brook of Middle River, Cape Breton 2004.

Name	Organization
Roddy MacIsaac	Cape Breton Sportfishing Advisory Council
Peter Embre	Cape Breton Sportfishing Advisory Council
David Richardson Sr.	Local Angler, River Denys
David Richardson Jr.	Local Angler, River Denys
Bernie/Ruthie	Local citizens of River Denys
John King	Local Angler, River Denys
Darryl Murrant	Hatchery Manger, Fraser's Mills
Stephen Thibeau	Hatchery Technician, Fraser's Mills
Francis Doyle	Local Angler, Lake O'Law Brook
Merryl Bustin	Department of Natural Resources, Whycocomagh
Dougald MacNeil	Department of Natural Resources, Whycocomagh
Don Anderson	Department of Natural Resources, Whycocomagh
Benedict Toney	Department of Natural Resources, Baddeck
Cathy Burton	Department of Natural Resouces, Margaree Depo
Carey Ross	Department of Natural Resouces, Margaree Depo

Table 2. Water temperatures in River Denys, Lake O'Law Brook in Margaree River, and Cold Brook in Middle River in Cape Breton, 2004.

Site	Data recorded	Equation*	r^2	25-30 May		June		July		August		1-10 Sep		Summer	Number of
				mn	max	mn	max	mn	max	mn	max	mn	max	mn	days > 20°C
River Denys estuary	25 May - 10 Sep			10	11	15	19	20	24	22	24	21	24	19.3	46
River Denys upper	25 May - 10 Sep			9	10	13	17	18	21	19	21	16	22	16.6	12
Margaree River main branch	8 Jul - 10 Sep	y = 0.78x + 2.2	0.82	10	11	14	17	17	19	17	17	14	20	16.3	0
Lake O' Law Brook Margaree River	8 Jul - 10 Sep	y = 0.79x + 1.5	0.74	10	11	13	17	16	19	14	17	16	19	14.6	0
Middle River main branch	8 Jul - 10 Sep	y = 0.63x + 4.6	0.83	11	11	13	15	16	18	17	17	14	19	16.5	0
Cold Brook Middle River	8 Jul - 10 Sep	y = 0.28x + 6.6	0.46	10	10	11	12	12	13	12	13	12	13	11.2	0

* regression analysis with temperature data from River Denys upper site was used to estimate temperatures that were missing between 25 May-8 Jul for sites in Margaree River and Middle River.

mn = mean

max = maximum

Table 3. The number of brook trout captured migrating upstream and downstream from River Denys, Lake O' Law Brook of Margaree River, and Cold Brook of Middle River in Cape Breton, 2004.

Month	Cold Brook 8 Jun-20 Aug upstream	River Denys 18 May-3 Aug upstream	River Denys 18 May-3 Aug downstream	Lake O' Law Brook 8 Jun-5 Sep upstream	Lake O' Law Brook 8 Jun-5 Sep downstream
May		49	45		
June	187	1152	109	79	15
July	671	770	0	573	0
August	1005	22	4	103	1
September				3	0
Totals	1863	1993	158	755	16

Table 4. Brook trout population estimates from River Denys, Lake O'Law Brook of Margaree River Cold Brook of Middel River in Cape Breton, 2004.

River	Marked	Captured	Recaptured	Population estimate
Lake O Law	576	196	14	7,574 (4,400 - 12,000)
River Denys	1,190	915	24	43,651 (30,000 - 67,000)
Cold Brook	884	989	39	21,887 (16,000 - 31,000)
Totals	2,650	2,100	77	

Table 5. The size structure of brook trout populations from River Denys, La' ? O'Law Brook of Margaree River, and Cold Brook of Middle River in Cape Breton, 2004.

River	Number in population	Percentages > 20cm	>25cm	> 30cm	> 35cm
River Denys	43,651	30%	13%	7%	2%
Lake 'O' Law	7,574	18%	5%	2%	1%
Cold Brook	21,887	9%	2%	1%	1%
Total / mean	29,461	13%	4%	1%	1%

Table 6. Mean length at age at the time of capture of trout populations from River Denys, Lake O' Law Brook of Margaree River and and Cold Brook of Middle River in Cape Breton, 2004.

	River Denys		Lake O' Law Brook		Cold Brook	
Age	Number	FL cm	Number	FL cm	Number	FL cm
1+	32	159	30	153	40	146
2+	41	219	53	216	49	209
3+	21	316	12	313	7	326
4+	6	414	3	372	1	395
5+					1	493

Table 7. Annual mortality rates based on the age structure of the trout populations from River Denys, Lake O' Law Brook of Margaree River, and Cold Brook of Middle River in Cape Breton, 2004.

	River Denys		Lake O' Law Brook		Cold Brook	
Age	Number	Mortality rate	Number	Mortality rate	Number	Mortality rate
1+	32	na	30	na	40	na
2+	41	49%	53	77%	49	86%
3+	21	71%	12	75%	7	86%
4+	6	100%	3	100%	1	0%
5+					1	100%

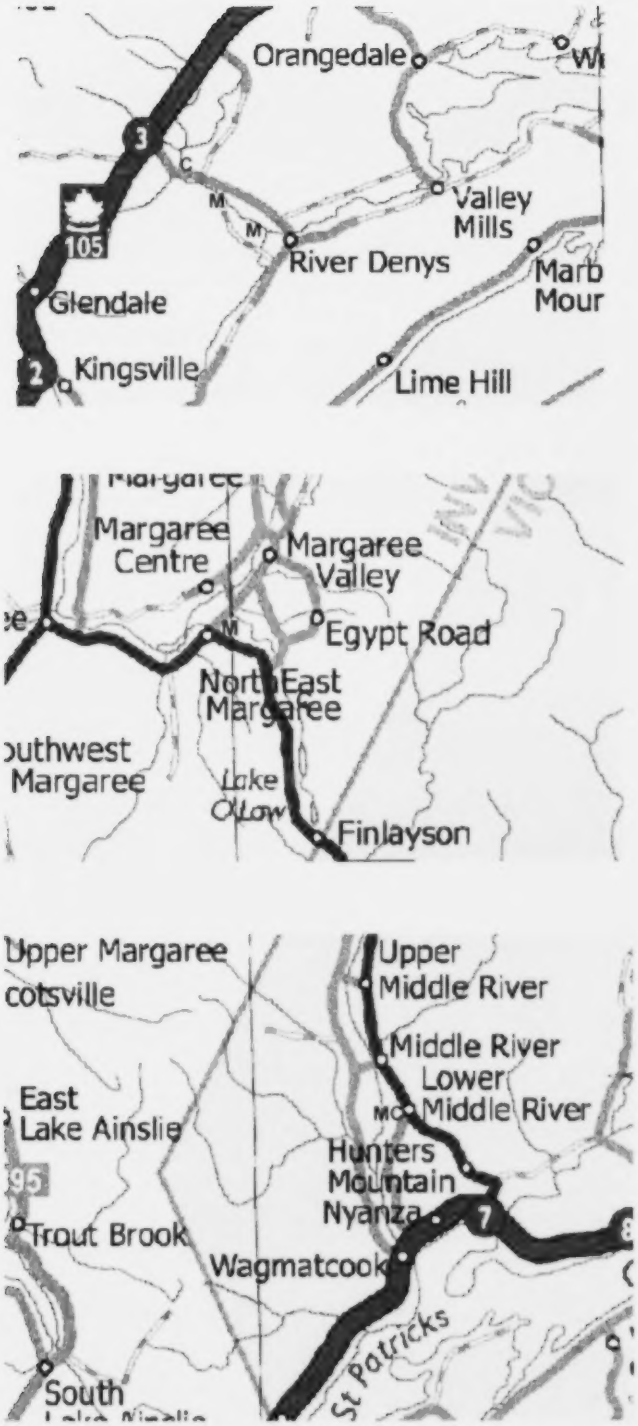

Figure 1. Location of marking (m) and capture (c) sites on the River Denys, Lake O' Law Brook of Margaree, and Cold Brook of Middle River in Cape Breton, 2004.

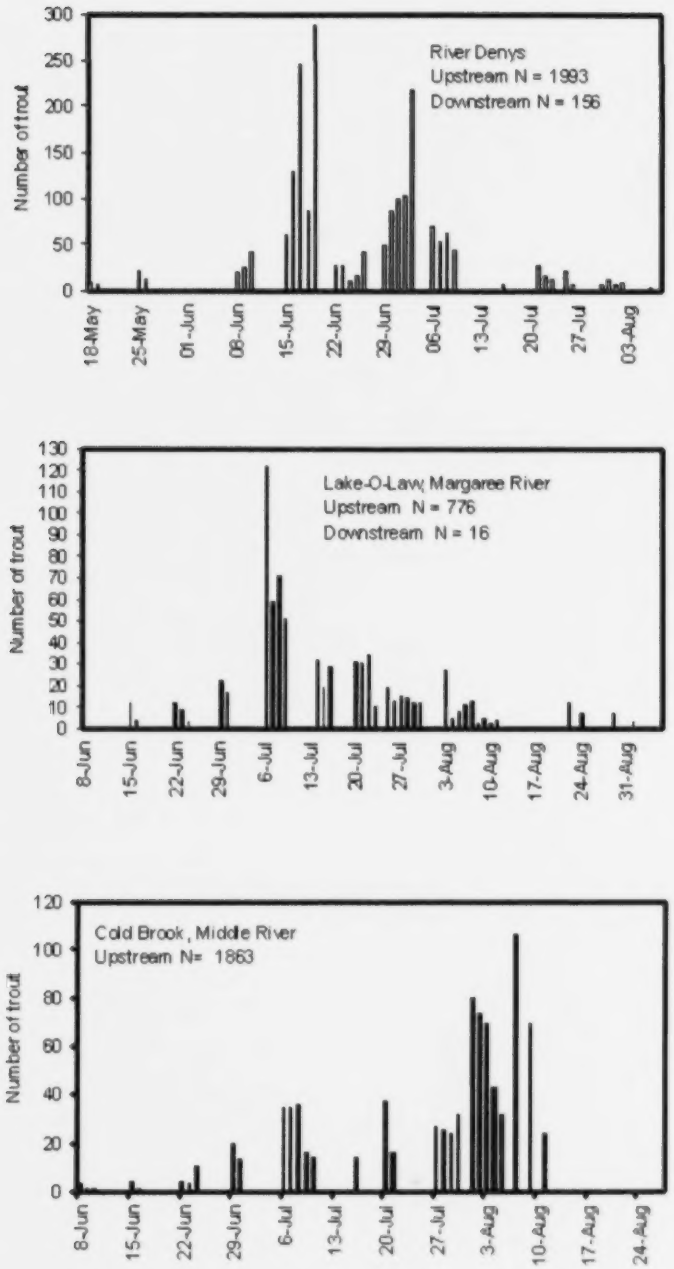

Figure 2. The number of migrating brook trout captured and time of migration in River Denys, Lake O' Law Brook of Margaree, and Cold Brook of Middle River in Cape Breton, 2004

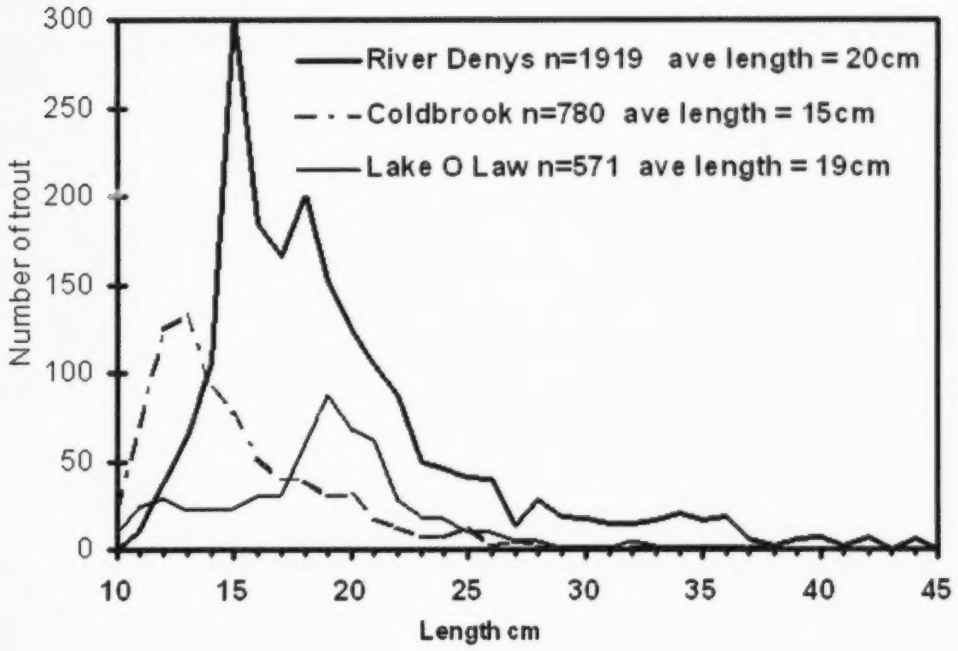

Figure 3. Length frequency distributions of brook trout populations from River Denys, Lake O' Law Brook of Margaree, and Cold Brook of Middle River in Cape Breton, 2004.